d a silver pin fitting into the socket; *e* a piece of sponge on the pin *d*, to hold the spirits.

Fig. 2, the spring and pin *d* separated, and without the glass; *ff* bits of leather cemented on to the ends of the spring, to make it hold in better and go in and out easier.

CERTIFICATE.

Sackville-street, Jan. 26, 1826.

This is to certify, that I have examined the new invention of Mr. J. P. Clark, which appears to me simple, ingenious, and useful, in the greatest degree, for the purpose of cupping; I have therefore recommended him to bring it under the observation and protection of the Society for the encouragement of Arts.

EVERARD HOME.

No. XVIII.

HAND-RAIL SECTOR.

The LARGE SILVER MEDAL was this session presented to Mr. C. HARTLEY, 4, Essex-street, Battle-bridge, for a Hand-rail Sector; a model of which has been placed in the Society's repository.

SIR, 4, Essex-street, Battle-bridge.

I BEG leave to lay before the Society of Arts, &c. a model and drawings of an instrument of my invention, which I

call a hand-rail sector. It will be found important in its application, though so simple in its principle, that it may be made and applied at a trifling expense by any mechanic whether in the practise of hand-railing or not.

The method of squaring hand-rails has been attempted by many; but no one, except Mr. P. Nicholson, whose name is so well known as a superior geometrician, ever explained or brought it to the correctness necessary for getting out the face mould.

The only inconvenience in Mr. Nicholson's method is the great number of lines to be drawn before the face mould can be got correct, so much so, that a workman, however familiar with it, is subject to mistakes entirely on account of the multiplicity of lines.

My idea is to bring this part of geometry into mechanism as much as possible, in order to prevent mistakes; and this end I hope will be found to be attained by the instrument herewith sent.

Its advantages are not confined to hand-railing alone, but may be extended to stonemasonry, or any work of double curvature, whereby much time will be saved as well as materials.

I am, Sir,

&c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

CHRISTOPHER HARTLEY.

CERTIFICATE.

James-street East, Chelsea,
March 22, 1826.

SIR,

I made an instrument from C. Hartley's model of his hand-rail sector about eighteen months since. I have struck

the moulds for the handrails of twelve different staircases, and find I can strike them out in one-tenth of the time, and with more correctness; I can also get the rail out of thinner stuff.

I am, Sir,
&c. &c. &c.
J. ROBSON.

A. Aikin, Esq.
Secretary, &c &c.

To render the following description of the instrument as popular as possible, the attention of the reader must be directed to those staircases in which the winders or triangular steps encompass a circular space which is called the well hole. The hand-rail forms the fence to the well hole, enclosing therefore horizontally a circular opening, and rising vertically at the same time to correspond with the rise of the stairs. This portion of the rail is in fact precisely similar to a portion of the thread of a common cork-screw, greatly magnified, of which a little reflection will show that no four points in the same revolution can be in the same plane.

In practise, however, economy as well as convenience demands that the mahogany or other material out of which the handrail is to be manufactured, should be cut into planes or planks of not much greater thickness than the intended substance of the rail. To cut these planes or planks of mahogany into a spiral form, with as little waste of material and labour as possible, is a great desideratum, and the means of doing it has generally been a nostrum in the hands of a few journeymen, possessing greater skill or intelligence than their fellows, and who have thereby enjoyed a sort of monopoly, frequently injurious, and very

often vexatious, to their employers. The attempts to remedy this evil by the invention and publication of refined geometrical methods, ingenious and beautiful as they are, have been, as might be expected, totally useless, the methods having been utterly beyond the reach of the most intelligent of those to whom they were addressed, and much too tedious and complicated for the use of a workman.

To provide a sufficiently accurate mechanical substitute for these more perfect but impracticable methods, is the object of the present invention, which places an approximate solution of this difficult problem within the power of any artisan of ordinary dexterity and application.

The most common form of a well hole is that of a long parallelogram, with a semicircle at each end, and to this form the present description will be applied. Fig. 5 in the print will represent the semicircle at one end of such a parallelogram divided into equal parts at the line No. 3, at which place there is always a joint in the rail, the mahogany forming only a quadrant in one piece. Suppose No. 1 to be the lowest point of the semicircle, No. 2 will be the highest, and No. 3 an intermediate point. The instrument shown in a plan and view, figs. 1 and 2, finds the form of only one quadrant of the rail at a time, say from No. 1 to No. 3, and it is thus adjusted to the operation.

The centre of the upright circular shaft *c c*, fig. 1, is made to coincide with the intersection of two of the lines on the base of the instrument, whose numbers express the diameter of the well hole in inches, those lines being marked

from six to twenty-two or more for this purpose. To facilitate this adjustment, the shaft *c c* is fixed to a horizontal slider *b*, which is secured by a screw *d*. In the print the centre of the shaft is at the intersection of the lines 18, 18, our imaginary well hole being eighteen inches in diameter; *e e e* are three square tubes containing three sliding stems *f f f*, Nos. 1, 2, and 3, which terminate in sharp steel points at top, and which may be fixed at any elevation in their respective tubes by the screws *g g g*. The place of the middle one of these tubes and stems is constant, the others are placed on those lines at whose intersection the shaft *c c* stands. The tubes always stand in some part of the lines *e e*, which connect them, and the distance of the lines 6, 8, 10, &c. is so arranged, that the distance between the moveable tubes and the shaft is always 3, 4, 5, &c. inches, being the radius of the well hole of which the numbers on the base indicate the diameter. The three tubes and the shaft therefore always form a square, which inscribes a quadrant of the well hole, *c* being the centre, and the two moveable tubes corresponding with the points No. 1 and No. 3 in fig. 5.

To adjust the height of the stems *f f f*, reference must be had to fig. 4, which represents what is called the *falling mould*, being an upright section of the rail developed from its circular plan, and exhibiting the rapidity of its rise or inclination from the horizon at every part. The falling mould is divided at No. 3, in accordance with the similar point on the plan fig. 5, and the space between Nos. 1 and 3 is again divided at *m*; *l m* and *m n* are then drawn so as to give the average inclination of the mould; that is, they are tangents to the mould at the middle of their lengths respectively. A bevel is then set to the angle which *l m*

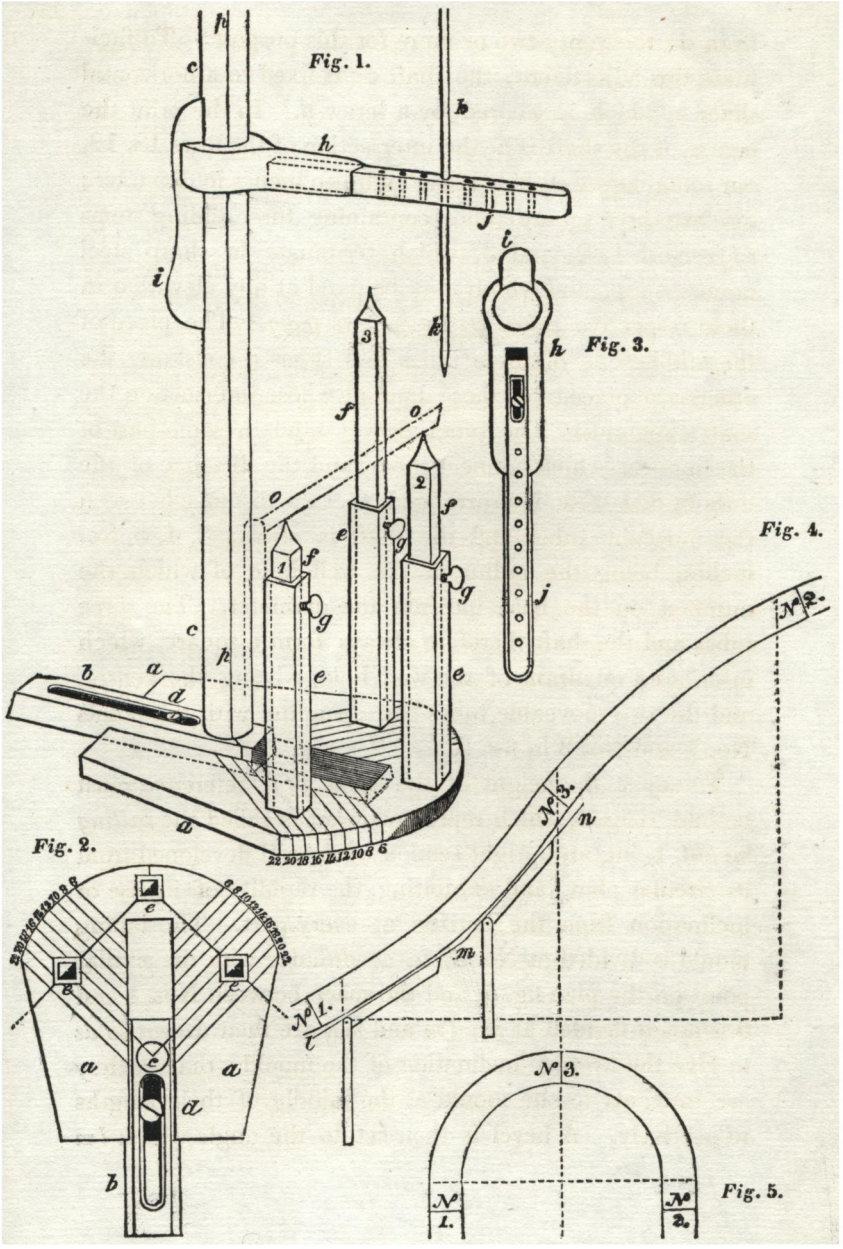
Fig. 1.
Fig. 3.
Fig. 4.
Fig. 2.
Fig. 5.
№ 1.
№ 2.
№ 3.

forms with the vertical line, and then being applied to the square stems *f* 1 and *f* 2, their tops are set to form the same angle with the perpendicular. The bevel is afterwards set to the angle made by *m n* with the vertical, and this angle in like manner regulates the height of *f* 3 above *f* 2. A thin board is now to be laid resting on the three points *f* 1, *f* 2, and *f* 3, while the pencil *k k*, fixed in the arms *h j*, which revolves freely round the shaft *p*, is made to describe two quadrants of different radii, similar to Nos. 1 and 3, fig. 5. The pencil may be fixed to any radius by means of the holes in the arm, and it accommodates itself to the slope of the thin board by the power of the arm *h j*, to slide vertically on the shaft, in which motion it is kept steady by the guide *i*. The lines described on the thin board by the pencil will be two quadrants of ellipses, and the board being cut in these lines, the space enclosed between them is called the *face mould*, which is afterwards applied to the mahogany, and guides the saw in cutting it; the saw always cutting at the same angle in reference to the plank, as the pencil has formed with the face mould; or, in other words, it is cut as if the plank had at once been laid on the points *fff*, and the pencil *k k* had been a cutting instrument which pierced its whole thickness.

The other quadrant from No. 2 to No. 3 is exactly the reverse of this, and is found without the assistance of the instrument.

The piece thus cut out of the plank requires only to be dressed into the desired form of the hand-rail, a process which must depend upon the eye of the workman, but which is of little difficulty compared with what has been effected by the instrument.

In order to cut the ends of this piece so as to make accurate joints with the other parts of the rail, care must be taken before the face mould is removed from the points *fff* to mark its surface with two lines exactly and vertically over 18, 18, or those on which the tubes and stems 1 and 3 stand. To facilitate this, two lines are drawn on the stem *c c*, one of which *p p* is seen, and which contain between them an exact quadrant; a straight edge then being placed with its edge coincident with the end of the line 18 on which the tube stands, and ranged out of winding with the line *p p*, will be a guide for one end, and the line *p p* a guide for the other end of a ruler which will describe the line required.

Fig. 3 shows the underside of the arm detached from the shafts, by which it will be seen to possess a power of minute adjustment as to length, independent of the holes which receive the pencil.

Fig. 2 is a plan of the base of fig. 1.